

JACOBI (A)

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INFANT DIARRHEA
AND
DYSENTERY.

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Clinical Professor of Diseases of Children, College of Physicians and
Surgeons, New York.

*Reprinted from the AMERICAN JOURNAL OF OBSTETRICS AND DISEASES OF
WOMEN AND CHILDREN, Vol. XII., No. III., July, 1879.*



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OF all the deaths in the first year of life forty per cent, in round number, are due to diseases of the digestive organs, and half as many to such of the respiratory organs. In the second year, the main cause of death changes completely, for of all the forty-five deaths taking place in that year, but nine are due to digestive, and thirty-six per cent to respiratory disorders. Thus in the first year, stomach and intestines, in the second, bronchi and lungs, are the sources of high death-rates. The respiratory organs are better protected, usually, in the first year, and the digestive organs treated more improperly. Such infants as survive the first are exposed to the same parental ignorance and carelessness concerning the requirements of the respiratory organs during the second.

Mortality diminishes with every day of advancing life. Every additional hour improves the baby's chances for preservation. Almost one-half of the infants dead before the end of the first year, die before they are one month old. Thus the causes of disease are the more active the earlier they are brought to bear upon the young with their defective vitality.

Two grave conclusions are to be drawn from this fact. The first is, that the diminution of early mortality depends on

avoiding diseases of the digestive organs by insisting upon normal alimentation. This is principally important in the first few months. While breast-milk has been shown to lower infant mortality through the whole first year, it does so more in the first few months. Thus, though an infant may not be fed on breast-milk through the whole normal period of nursing, a great gain, indeed, is accomplished by insisting on nursing, though for a limited time, perhaps two months only. There are but few mothers but will be capable of nursing during that brief time, and none who ought to be spared the accusation of causing ill-health or death to her baby if she refuses to nurse it at least through the first dangerous months. The second conclusion, resulting from many figures, is this, that the dietetic problems and rules for the infant concern the digestive organs mainly, so much so, indeed, that infant dietetics and the dietetics of the infant digestive organs appear nearly identical.

It is true that in this city we meet with a high mortality, even in children of more than a year. The second summer is regarded with awe and fear amounting to superstition. In fact, public opinion looks for a higher mortality in the second than in the first summer. The fallacy of this assumption can be easily corrected by the statistical reports; and the high mortality rate itself could be easily reduced by such parents as would feel convinced that it is external causes which kill their children, and not the natural course of development. The second summer is the period of danger in part only because of the heat of the season, but mainly of the errors in feeding. Conscientious and intelligent families in good circumstances are not apt to lose their infants in their second summer.

Nor is it necessary that here, and on this occasion, I should insist upon the danger incurred by the belief that diarrhea—a pathological condition—is a normal attendant on and a relief of a physiological process such as dentition. This much is certain, that very few, if any, popular beliefs have been more destructive than this, that an intestinal catarrh must be left alone, no matter from what source it originated.

Healthy infants have a normal tendency to loose, liquid, or semifluid evacuations from the bowels. The causes lie partly in the condition of the intestinal tract, and partly in the nature

of the normal food, viz., breast-milk. The peristaltic movements are very active; the young blood-vessels are very permeable; the transformations of surface cells very rapid; the peripheric nerves very superficial, more so than in the adult, whose mucous membrane and submucous tissue have undergone thickening by both normal development and morbid processes. In the young infant, the peripheric ends of the nerves are larger in proportion than in the adult, the anterior horns of the nerve-centres are more developed than the posterior ones. Thus the greater reflex irritability of the young, particularly in regard to intestinal influences, is easily explained. Besides, the action of the sphincter ani is not quite powerful, the feces are not retained in the colon and rectum, and no time is afforded for the reabsorption of the liquid or dissolved constituents of the feces. Moreover, the frequency of acids, sometimes normal, in the small intestines gives rise to the formation of alkaline salts with purgative properties. Hoppe-Seyler found free acids in the feces of dogs and adults. Wegscheider met them in nurslings who received nothing but mother's milk. An explanation of this occurrence may be this, that the quantity of food is often too large, but it is just as probable that the amount of digestive fluid is too small. For the diastatic effect of the pancreas is limited at that as at any other age.

The nature of breast-milk, even when absolutely normal, is such as to facilitate frequent, large, and fluid evacuations.

First, as to its fat. Careful investigations led Wegscheider to the following important results: *fats are not completely absorbed; one part leaves the intestine in a saponified condition; a second part, as free, fatty acid; a third, as fat in an unchanged condition.*

Where no food is given but mother's milk, which contains fat in proportionately smaller quantities than cow's milk, and finely suspended and easily absorbed, *a good deal of fat is eliminated* without any change.

What has been called detritus in the feces is not all undigested casein, but, on the contrary, it is mostly fat, and very probably remnants of intestinal epithelium. This milk detritus, so-called casein, and mainly consisting of olein, margarin, and stearin, is not soluble in water, acids, or alkalies, but very soluble in alcohol and ether.

Practically this *fact* is of the very greatest importance. Fat is not completely absorbed under the most normal circumstances. Fat-acids are easily formed, and accumulate to such an extent that they are found in moderate quantities in even the healthiest nurslings. Superabundance of fat-acid is a common derangement of digestion and assimilation, and it impedes the previously normal secretion of other digestive fluids. Thus there is a *plus* of fat, even in the normal food of the nursling, the breast-milk.

The conclusion, then, which I will record here at once, is that we have to be *very careful in the preparation of artificial food*. *It is almost certain that we give too much fat; it is scarcely ever probable that there is too little*. Therefore the addition of cream is reprehensible, no matter in what shape. Whenever cream and cream mixtures have been recommended, inventors and backers have always made the statement that such mixtures are, "as a rule," well tolerated. It is a doubtful praise, however, that food should be simply well tolerated, "as a rule." The fact alluded to has probably been the cause why Liebig has, in his artificial food, only *forty* per cent of the fat contained in mother's milk.

Thus in the most normal milk there is more fat than required. Whenever changes set in, the disproportion can be greater yet. For milk is no stable article, its chemical composition permits of a great latitude indeed. Normally it is the result of transformed glandular substance.¹

The mammary gland is no filter, through which the serum of the blood, or the solutions of salts, or the transformed foods are rendered accessible to the hungry young. The quality and quantity of milk depend upon the development of the gland. Milk is not the product of the action of the cells; it is the transformed cells, the very organ. Thus the nursling is the veriest carnivorous animal. As long as the epithelium has not undergone a total change, the secretion is not milk, but colostrum, with its large globules. The character of the gland influences the milk, much more than food. The latter influences milk only by building up the gland, the cells of which

¹ Compare "The Influence of Menstruation, Pregnancy, and Medicines on Lactation," by A. Jacobi, M.D., in *AMER. JOUR. OBSTET.*, July, 1877.

receive materials of different kinds, the principal of which is albumen.

In accordance with this, the nature of milk is beautifully illustrated by its chemical composition. Its ashes are tissue ashes, not those of plasma, for they contain much potassa and phosphate of lime, but little chloride of sodium.

In the first period of lactation the glandular transformation is not yet accomplished. The secretion is of a different nature. It requires days to exhibit casein. Until then the protein shows the nature of albumen. At the same time the percentage of butter and salts is very high indeed, both of which explain the *laxative* character of colostrum. No less do macroscopic and microscopic observation convey the impression of its being incomplete. It is yellowish, thickish, the fat globules are large, unequal, sticky, and mixed with epithelium almost unchanged. There is less potassa and more soda than in normal milk, approximating it to the chemical character of plasma. Besides, colostrum of the cow has not unfrequently been found to contain blood and to coagulate when being boiled. Thus colostrum is more like a transudation than a glandular secretion. Such colostrum is not only met with in the first week after confinement, but in disturbances of the general health, in anemia, fevers, pregnancy, or advanced age of mother or nurse. Also when the gland itself is insufficient, or the woman too young, or slowly convalescent, or neurotic and liable to vaso-motor disturbances. The administration of such milk disturbs the health of the infant through the bringing on of gastric or *intestinal catarrh*.

Thus there is no stability in the nature of breast-milk, and very much less in the human than in the animal female, for obvious reasons. Its constituents and effects may even change from hour to hour, from day to day, sometimes it will be milk, sometimes milk with transuded serum.

That a mere transudation should contain all sorts of material circulating in the blood-plasma is evident. Therefore colostrum is apt to transfer to the nursling the liquid constituents of the mother's blood, no matter whether normal or abnormal, beneficial or injurious, organic or inorganic. The reports of infants harmed by the mother's opiate, influenced by her taking mercury, belong, therefore, mostly to the earliest period of

lactation, or to a period of sickness or debility on the part of the woman. The more normal the mammary secretion the less the danger in this respect. Very few persons, however, are always in undisturbed health.

Thirdly as to sugar. It is abnormally plentiful in colostrum, and in some milks, at times, its percentage is lower than normal. In the former it is purgative, in the latter its absence one of the causes of constipation. Thus the addition of a piece of sugar—which need not be milk-sugar—to breast-milk is apt to heal constipation in the infant. I dissolve it in the smallest possible quantity of water, say a teaspoonful, and let the baby take it before each nursing.

Fourthly as to casein. When present in an abnormally high percentage, it may act in two ways. It will either constipate, particularly as the high percentage of casein and a low one of sugar go hand in hand, mostly—or by remaining undigested, and acting as a local irritant, thereby producing diarrhea. In these cases of diarrhea the stools are mixed with white flocculi, small or large, sometimes in astonishing quantities and for a long period. The treatment of such diarrhea is by no means very simple, unless the breast-milk is changed. When such a change cannot take place, I add oat-meal gruel or barley-water in such a manner, that a few teaspoonfuls of it are administered to the baby before each nursing. I shall return to the consideration of this proceeding.

The natural food of the infant being sometimes a cause of tendency to diarrhea, and of actual diarrhea, the administration of artificial foods must necessarily be inferred to threaten a real danger. Let us examine some of the articles of food mostly used for the young.

Goat's milk ought to be rejected because of its large percentage of fat, not to speak of its odor which at times is very disagreeable.

Cow's milk contains more butter than human milk. If the latter, as stated above, is not entirely digested, cow's milk butter will certainly leave even more remnants to encumber the intestinal canal.

The reaction of human milk is alkaline, that of cow's milk rarely to the same degree. It is apt to become acid soon

after milking, and has been found to exhibit acid reaction while still in the udder.

But the main difficulty lies in the large percentage and in the nature of the casein of cow's milk.¹

The casein of cow's milk and the casein of woman's milk are two different substances. When isolated by alcohol, by which both are thrown out of their combinations to a certain extent, the chemical properties are found to differ widely. Thus obtained, cow's casein, when moist, is white; when dry, yellowish. It reddens litmus-paper, and acidulates water, in which it is soluble in the proportion of 1-20. Woman's casein, however, in its moist condition, is yellowish, alkaline, or neutral, and dissolves almost entirely in water, the solution being of neutral reaction. Vierordt and Biedert found the quantity contained in the two milks to differ, there being less in woman's milk than in cow's milk.

When exposed to artificial gastric juice they also act differently. In a surplus of it woman's casein is dissolved in a short time; cow's casein in twenty-four hours. Mineral acids, lactic acid, acetic acid, tartaric acid, Epsom salts, phosphate of lime in solution, coagulate cow's milk in hard and dense masses; not so human milk. Solutions of both kinds of casein in alkalies show many similar properties; but the sediment produced by the addition of lactic acid can yield essential differences. Thus there is a chemical as well as a physical difference between the two species of casein. Although their relation to artificial gastric juice has not been found to differ to that extent by Dr. C. P. Putnam, of Boston, it is upheld by a number of other observers, and the fact is beyond doubt that pure cow's casein is very much less digestible than human casein. At all events, it should be so considered, and infants should have only as much casein as proves digestible. One of the alleged means of combating the improper effect of casein is to increase the relative amount of fat by adding it to the food. It is true that in this way a more proper relation of the two can be obtained, but certainly no more proper relation of the two to the insufficient condition of the infant digestive organs.

¹ The following page, and some other statements in this paper, may be found in an essay of the author's incorporated in the forthcoming volumes on Hygiene, to be edited by Dr. A. Buck, and published by Wm. Wood & Co.

Besides, the addition of cream to either casein or fresh milk has something very doubtful about it, as at the time when cream has formed upon milk, by simply allowing it to stand, the formation of lactic acid is going on all the time. At all events, no addition we know of can render cow's casein more digestible than Nature made it, and the only thing which can be obtained by any sort of manipulation of the milk is to make it less injurious. Perhaps, however, the plan upon which Dr. J. Rudisch has acted may recommend itself to the attention of the practitioner. In order to make cow's milk more digestible, he has introduced into my practice a mixture which promises to be of great value in all those cases in which coagulability of the milk is the prominent obstacle to its usefulness. The mixture suggested by him, and used by us up to this time mainly in diseases of adults, such as anemia, gastric catarrh, ulcer of the stomach, slow convalescence, etc., is the following: to one pint of water, one-half teaspoonful of officinal dilute muriatic acid is to be added. To this mixture add one quart of raw cold milk; mix the two liquids thoroughly and then boil for ten or fifteen minutes. I have found this preparation to be very digestible, and well tolerated by very feeble digestive organs. Not only clinical experience favors this preparation, but direct experiments also. When "liquid pepsine" is added to common milk, coagulation takes place very rapidly, and in thick coherent masses. The same liquid pepsine, when added to the above mixture, produces so slight a coagulation that it can scarcely be observed. The coagula also are small, and do not adhere firmly to each other. Essence of rennet coagulates common milk speedily and completely; the above mixture more slowly and not so completely. The coagulation of common milk exhibits, after a certain time, thick, dense, and firmly coherent masses. The coagula produced by the above mixture are fine, loose, and are easily separated when the liquid is shaken.

Valuable as this preparation of cow's milk may prove in future, there is one method for making cow's milk more available, which is at once simple and effective. No cow's milk ought to be administered without the addition of chloride of sodium. Not only cow's milk, but also—and even much more so—farinaeous admixtures to cow's milk require its presence in the food.

The method of preparing condensed milk with the admixture of such great quantities of sugar as to yield from thirty-nine to forty-eight per cent of sugar in its solid ingredients is a well-known process. With regard to this preparation, Kehrer says that when sufficiently diluted it readily induces the formation of lactic acid, and that delicate children will not thrive on it. In such cases he deems it necessary to add barley-water or oatmeal gruel as well as antacids. Fleischmann also accuses it of causing a predisposition to thrush and diarrhea. He lays stress upon the fact that, even when it has been properly diluted, the proportion of the protein compounds to the carbohydrates is diminished, and thereby its nutritive value impaired. My own experience with condensed milk, which has been rather extensive, has led me to learn that, when diluted simply with water, even though to the proper degree, it is apt to be followed by disagreeable results; although the influence of the large amount of sugar does not operate in the manner as above alleged. For the sugar which is added to condensed milk is not the easily decomposed milk-sugar. Yet catarrh of the stomach and bowels is a frequent result of its use. I have seen few children enjoy undisturbed health who were fed exclusively upon condensed milk. Those, however, who take it mixed with a certain proportion of barley-water, either regularly, as I recommend, or in cases of temporary necessity, as advised by Kehrer, thrive quite well. I cannot say that I have been able to discover any material difference, whether condensed milk, or good ordinary city milk, was given in this way. But it should not be forgotten that barley-water is a more desirable addition to the mixture than oatmeal gruel, because of the laxative effect which the latter may have. If the condensed milk be given in this way, we need not fear a repetition of Daly's experiences. He found that children took the condensed milk readily, and grew fat; but in case they fell sick, they showed but slight endurance; they began to walk late; their fontanelles were slow in closing, and other signs of rhachitis showed themselves.

The preventative treatment of diarrhea, depending on defective alimentation, consists in so changing and arranging the milk used for babies that the casein will not coagulate in large lumps, and thus become more digestible. That object can be

obtained by adding such farinaceous food as does not contain much starch. Some little starch is digested from the first days of life, the parotid having diastatic effect; in a few months after birth such vegetables as contain starch in moderate, but not overwhelming percentage, may be used as additional infant food. Still it is not absolutely necessary that every particle of ingesta should, in all instances, be digested and assimilated. That is impossible; the very breast-milk contains such amounts of fat that it cannot all be digested and absorbed. The requirement is only that not enough should remain undigested to encumber and irritate the intestinal tract.

The principles on which I base the theory of this treatment is simple enough. It has been published in my *Infant Diet*, and will again appear in the forthcoming volume on *Hygiene* alluded to above. Some of it has also been published by a former clinical assistant of mine, in a previous number of the *JOUR. OF OBST.*, years ago. It consists in diluting the boiled and skimmed milk with barley-water or oatmeal gruel. It must be boiled to check its tendency to become sour, to remove a portion, though small, of its casein and fat, and to expel the gas contained in the raw milk to the amount of three per cent.

Of the two, as may be known, I prefer barley for general use.

The prepared commercial barley is characterized by its fineness and whiteness. But these qualities are suspicious characteristics; the less the quantity of the yellowish outer layers of the barley, the less is it to be recommended. The prices of the grain, though low, vary in such a manner that adulteration by refining pays very well. I would, therefore, recommend that the barleycorn which is employed for infant diet should be ground as thoroughly as possible in a coffee-mill, both in order to diminish the period necessary for cooking it, and also in order to retain the gluten. *It is even preferable, for very young infants, to cook the barley whole for hours*, thereby to burst the outer layers of cells, empty their contents, and then, by straining, to get rid of the larger part of the starch which is found toward the centre. The next best method consists in crushing the whole grains of barley, and not to employ the so-called pearl barley, which is barley minus husk. At a more advanced period of life the latter preparation, with its greater

amount of starch, will suffice, however, because oatmeal, on account of its larger percentage of fat and mucin, is more liable to relax the bowels. In other respects the chemical composition of the two is so nearly alike that it would be immaterial whether we choose one or the other. But there is no danger to which little children are so liable as that which arises from their tendency to diarrhea. My advice, therefore, is to administer barley to children who manifest a tendency to diarrhea, and oat-meal to those having a tendency to constipation, and, whenever a change occurs in the intestinal functions, to give one or the other, according as constipation or diarrhea predominates.

I hold this mixture to be the *conditio sine quâ non* of the thorough digestion of the milk. It, only, will insure the proper nourishment of the infant. With this food alone I have seen children endure the heat of summer without any attack of illness whatever. It is because I am so deeply convinced of its importance that I return to the subject here. In this climate, so perilous to infant health, where severe derangements of digestion belong to the most common of the daily experiences of the practitioner, I have had occasion again and again to be convinced of the reliability of my mixture. It has this advantage, too, that it necessitates no dependence upon the honesty or competence of the apothecary or manufacturer, but this mixture can be prepared by any one, however poorly situated. I conceived it to be necessary to discover a kind of food, suitable to the infantile age, which *could not be spoiled through ignorance and fraud, nor be liable to have its price enhanced by trade dealers*. All of these indications have been fully met in the preparation which I have described.

The object I desire to attain is to insure a slow action of the gastric juice, or of the excess of acid in the stomach upon the casein of the milk, and this object I attain under all circumstances. Should a slight diarrhea occur, or a little casein be vomited (a rare accident, to be sure), or casein occur in the stools, then all that is necessary is to diminish the proportion of milk. It may sometimes be necessary, though very seldom, to withdraw the milk entirely for a time, but only in cases of real illness. If the physician or attendants have properly apportioned the ingredients of the mixture, we may be rather sure that the child's digestion and assimilation will be regular

and normal. Infants that are partly nourished at the breast almost invariably thrive well with the addition of my mixture. Children, from their fourth or fifth month and upward, may often be fed with it exclusively, and not unfrequently nothing else is given from the day of the birth. I can positively affirm that in all these cases assimilation and increase in weight have proceeded quite normally. Altogether, the brief form in which I laid down the above principles, years ago, and in which they have been published several summers by the New York Health Board (See *Infant Diet*, 2d Ed., 1876, p. 118) for the benefit of the general public, rich and poor, has always been found satisfactory.

The addition of barley or oat-meal for the purpose of rendering milk digestible is not, however, absolutely indispensable, though I have learned to prefer them. For gum-arabic and gelatine are also very valuable ingredients, indeed, of infant foods.

As far as the former is concerned, Frerichs, Lehmann, and Husemann did not admit its undergoing any change in the human body. Gorup-Besanez believes in its solubility, but not in its digestibility; hence if, in his opinion, gum-arabic is an important aid in digestion, it is so for one reason only, namely, that it acts mechanically, and renders the coagulation of milk less dense. Of late, however, Uffelmann has made some experiments with a solution of gum-arabic of the strength of *eighteen* parts of the gum to *two hundred* of water. His experiments were made upon a boy upon whom gastrotomy had been performed, thus affording opportunity for making direct observations. When he introduced this solution into the boy's stomach, he found grape-sugar after some time, no saliva being present. The same transformation has been observed in the Munich laboratory.

Fifteen grammes of the above solution yielded *five* centigrammes of grape-sugar after forty-five minutes; *thirty* grammes gave *twenty-eight* centigrammes after *sixty* minutes. The liquid taken from the stomach in the latter case was very acid indeed. It matters not whether this acid was inside the stomach previously, or was developed during the presence of the gum-arabic solution; in both instances it appears that the development of muriatic acid and the transformation into grape-

sugar go hand in hand. It is possible, then, that it will be found practical, in those cases in which the object is not simply to mix milk with gum-arabic, but also to derive benefit from the digestion of the gum, to add a small quantity of muriatic acid.

Gelatine, in the opinion of many, when combined with milk, fulfils two indications. The one is the same as that obtained by the mechanical effect of gum-arabic and farinaceous articles; the other is found in its usefulness as a tissue-building material. Guérard quotes Jean de Lery, who speaks as follows: "Ayant expérimenté que cela (skins, parchemin) vaut au besoin, tant que j'aurais des collets de buffles, habits de chamois, et telles choses où il y a suc et humidité, si j'estois enfermé dans une place pour une bonne cause, je ne me voudrois pas rendre pour crainte de la famine." Papin is reported to have made the offer to Charles II. of England to furnish for the use of poor-houses and hospitals "un quintal et demi de gelée" with "onze livres de charbon." This offer was refused because a dog was paraded before Charles wearing a sign-board containing said dog's request not to be deprived of his mess of bones.

The French Academy of Medicine has taken great pains to discover the properties of gelatine. After Magendie in 1848, Vrolik in 1844, Bérard in 1850, and Edwards and Balzac, had published their reports upon the subject, Guérard comes to the following conclusions: 1. That gelatine is very nutritious; 2. That very probably it is of great importance in the process of building up cellular tissue, therefore absolutely necessary for the preservation of life. Frerichs, Metzger and De Bary, Schroeder, Kuehne, and Etzinger, found that gastric juice changes gelatine in such a manner that it loses the property of gelatinizing. This effect was not produced when it was treated with muriatic acid only. On the other hand, Imthurn also attributes the effect to the influence of muriatic acid. It is true that Meissner and Kirchner have entirely denied the changeability of gelatine by means of gastric juice. But Gorup-Besanez is of the opinion that gelatine is peptonized in a manner similar to the albuminates. It seems that Uffelmann has also settled this question. He found, in the gastrotomized boy, *first*, that while he was feverish, and again without fever, the

gelatine was speedily dissolved in the gastric juice. It was so modified at the end of one hour that it would no longer coagulate, and was easily diffused. To produce this change by means of artificial gastric juice, he found, however, that from eighteen to twenty-four hours were necessary, and in both instances there was no offensive odor. When the experiment was performed within the stomach, he occasionally observed the presence of grape-sugar. When that occurred, the temperature of the body was elevated. No grape-sugar was ever found when the gelatine was exposed to the action of artificial gastric juice. Gelatine digested in gastric juice retains its essential chemical properties. It resembles peptone, inasmuch as it is not precipitated by acids. It differs from peptone, inasmuch as its diffusibility is less, and, when dissolved in acetic acid, it can be precipitated by ferrocyanide of potassium. It is so much like peptone that its digestibility can hardly be doubted, not to speak of the direct observations made by Uffelmann. There is one point, however, not to be lost sight of, viz., that it is apt to putrefy, and therefore requires the addition of a small quantity of muriatic acid. The latter point is of great practical importance; for, in acute diseases, in slow convalescence, in anemia, the secretion of pepsine and muriatic acid is very much limited. For that reason muriatic acid should be added whenever gelatine is administered.

When it is to be mixed with milk, in such cases, the plan as recommended by Dr. Rudisch, and specified above, will perhaps be found most useful.

Curative Treatment.—So far as nutriment is concerned, the amount of food should not be larger than we have reason to expect can be easily digested. At all events, either lengthen the intervals between the meals or reduce the quantity of food given at one time, or both. When diarrhea makes its appearance in infants who have been weaned, it is desirable to return them to the breast. Those who never had breast-milk may be given the breast if they can be induced to take it, but only rarely will this be found possible. Whenever a child at the breast is taken with diarrhea, the passages from the bowels should be studied as to their contents. If a certain amount of curd is found in them, the least that is to be done is to mix the breast-milk with barley-water. This may be done in such

a manner that, each time before nursing, one or two teaspoonfuls of barley-water is given the child, so that the farinaceous food and the breast-milk will mix in the stomach. Or, it may be found advisable to alternate breast-milk and barley-water. In bad cases, particularly when the milk is found to be white and heavy and contains a great deal of casein, it be will found necessary to deprive the child *altogether* of its usual food. In such cases, the child will do better on barley-water alone (this to be continued for one or two days), than to expose it to the injury which will certainly follow the continuation of the casein food.

When diarrhea occurs in children who have been fed alone upon cow's milk, unmixed or mixed, it is necessary to reduce the quantity of cow's milk in the mixture. As a rule, we have to remember that cow's milk alone is apt to produce diarrhea, and it should be considered as a maxim that, whenever diarrhea makes its appearance, the amount of cow's milk given to the child should be reduced. When a mere reduction of the quantity does not suffice, it is very much better to deprive the child of milk food altogether. Not infrequently the removal of milk from the bill of fare is the only thing which will restore the child to health. It is possible that a mixture, such as recommended by Dr. Rudisch, of which I have spoken before, will be found digestible, even in such cases. My experience, however, is not sufficient to decide that point. In many cases, as a dietetic measure, it will be found advisable to add one or two tablespoonfuls of lime-water to each bottle of food with which the child is supplied.

In those cases in which barley-water does not seem to suffice as a nutriment, or where it would be dangerous to allow children to lose strength, a mixture which I have used to great advantage is the following: Mix the white of one egg with four or six ounces of barley-water, and add a small quantity of table salt and sugar, just sufficient to make the mixture palatable. The child can take this either in large or small quantities, according to the cases.

In such cases in which the stomach is irritable and vomiting has occurred, it is now and then better to give a small quantity, even one or two teaspoonfuls, and repeat the dose every ten, fifteen, or twenty minutes, than to give larger quantities at longer intervals.

In those in which the strength of the child has suffered greatly, it is necessary to add brandy to the mixture in such quantity that the child will take from one drachm to one ounce (grammes 4.0 to 30.0), more or less, in the course of twenty-four hours.

In those extreme cases in which the intestinal catarrh is complicated with gastric catarrh, where the passages are numerous and copious, and vomiting constant, where both medicines and food are rejected, there is frequently but one way to save the patients, and that is to deprive them *absolutely* of everything in the form of either drink or food or medicine. It is true that such babies will suffer greatly from thirst for an hour or two, but it is a fact that, after two or three hours, these children will look better than before the abstemious treatment was commenced. Not infrequently four or five hours of total abstinence will suffice to quiet the stomach and diminish both the secretion and the peristaltic movement of the intestinal tract. In some cases *six* or *eight* hours of complete abstinence will be required; or such children may be starved for even *twelve* or *sixteen* hours, with final good results. The first meals afterwards must be quite small, and they will be retained, and, as a rule, such children will subsequently do well.

I need not say here that, in addition to the dietetics for the digestive organs, it is necessary to supply the patient with as much cool fresh air as possible. The worst out-door air, when cooler, is better than close in-door air. The undeveloped condition of the nerve-centre in the normal infant, the relaxation of the inhibitory nerves by heat, the absence of radiation from the surface, the lacking stimulus—during hot weather—of the cutaneous sensitive nerves, the diminished metamorphosis of tissue, the diminution of the powers of digestion, not only by shortening nutrition, but by directly lowering the secreting powers of digestive glands in the stomach and intestines, are just as many factors in the production of the very worst forms of infant diarrhea.¹ I have kept very bad, desperate cases out all night upon the bluffs over the East river. The windows must not be closed. If possible, the children should be sent immediately to the country and into the mountain air.

¹ Compare: "Infant Diet," second ed., 1876, pp. 101-116.

The second indication consists in the removal of undigested masses retained in the intestinal tract. Not only in cases in which the diarrhea has resulted from previous errors in diet of the child, but also in those cases dependent upon sudden changes of temperature and exposure, it is desirable to empty the intestinal tract of its ballast. For that purpose castor oil, calcined magnesia, or calomel may be used. So far as the latter is concerned, the discrepancy of opinion with regard to its efficiency will probably be found to depend upon the variation in the size of the doses recommended by different authors. When a purgative effect is desired it should not be given in small doses, and, according to age, from *two* to *six* (0.1–0.4) grains should be administered.

Third. Nothing should be given that contains salts in any sort of concentration. Thus, beef-tea should be avoided. It has come very largely into use in practice among children both in this country and in Great Britain. In Germany, too, it has found very many advocates, and among some who have abandoned the obsolete notion that when prepared in the customary way it contains a large proportion of protein in its composition. It must be remembered that this form of meat-extract contains a very large amount of salts, and that the direct effect of these upon the intestinal canal may be productive of very unpleasant consequences. It is a mistake to give it when the intestines are irritated or very susceptible of irritation, for the reason that diarrhea is apt to directly follow its use. Nevertheless, I have often seen beef-tea given under these very circumstances for no other object than the vain one of furnishing the child with a great amount of nourishing food. This is very commonly done during the obstinate and exhausting diarrhea of summer. If the people insist upon giving it, and there is no special contraindication to its use, in a given case, it should be administered only in connection with some well-cooked farinaceous vehicle, and the best of all for this purpose is barley-water; or it may be mixed with beaten white of egg, but no more chloride sodium should be added. For the main danger in beef-tea is the concentrated form in which its salts are given.

Fourth. Everything should be avoided that increases peristaltic motion. Thus, carbonic acid and ice internally.

Fifth. Avoid whatever threatens to increase the amount of acid in the stomach and intestinal tract. There is so much acid in the normal, and still more in the abnormal stomach and intestinal tract, that it is absolutely necessary to *neutralize* it. For that purpose any alkali, perhaps, will suffice, but it is safer to resort to preparations of calcium than of sodium or magnesium. Soda and magnesia, when introduced into the stomach and duodenum, will find a number of acids and form laxative salts. Frequently I use carbonate of lime; not infrequently phosphate of lime. Both of these will act as antacids, but the latter preparation is to be preferred in those cases in which free phosphoric acid is deemed of importance for the purpose of facilitating pancreatic digestion.

So far as lime-water is concerned, its administration, certainly, is correct chemically. But we should not place too much reliance upon this popular remedy. We should not forget that it contains about one part of lime to eight hundred of water, and that it is necessary to swallow at least *two* ounces of the fluid in order to obtain a single grain of lime.

A further indication is, *the necessity of destroying ferments*. For that purpose most metallic preparations will do fair service. One of these, that has been extensively used, is *calomel*, and now in *small doses* frequently repeated— $\frac{1}{10}$, $\frac{1}{4}$, or $\frac{1}{2}$ a grain (0.1–0.15–0.03), every *two* or *three* hours. As to its effect as an anti-fermentative, there can be no doubt. It is very uncertain, however, as to how it produces this effect. It is possible that it acts by a portion of the drug being changed very slowly to the bichloride of mercury, which is known to be a very powerful agent in the prevention of fermentation. It is certain that one portion, at least, of the mercury is used to bind sulphide of hydrogen, which often acts in a poisonous manner. Infants will bear calomel very well, perhaps for the reason that elimination is so much more rapid in them than in adults.

Nitrate of Silver, when given for the same purpose, should be largely diluted. From $\frac{1}{40}$ to $\frac{1}{10}$ of a grain (0.0015–0.004), dissolved in a teaspoonful or tablespoonful of water, may be given every *two* or *three* hours, and not infrequently with fair result. At all events, it does not answer to use a concentrated solution. Whenever it is concentrated, it acts more as

a caustic than as an astringent. This remark is especially important with regard to injections of nitrate of silver into the rectum, where it is apt to do as much harm as good. Even a mild solution—one or two grains to the ounce of water (1: 500 or 250)—when injected into the rectum is apt to give rise to tenesmus and soreness about the anus; whenever it is to be given in that way, the solution should be mild and largely diluted, or the anus and its neighborhood should be washed with salt water before the injection is administered.

Bismuth acts very favorably. Moderate cases of diarrhea will usually show its effect very soon. Doses of from $\frac{1}{2}$ to 2 or 3 grains (0.03--0.20), given every *two* or *three* hours, will act very favorably indeed. In those cases in which the diarrhea has lasted for a long time, and a large surface of the intestinal tract is certainly implicated, the doses of bismuth should be large in order to be certain of immediate contact of the drug with the sore surface.

A *final indication* is the depression of the hyperesthesia of the general system and of the intestinal tract in particular. The effect of opium is very probably an anatomical one, and brought about in such a manner that a combination takes place with the nerve plasma. As this is so much softer and succulent in the child than in the adult, the effect is so much stronger. There have been authors who condemned the use of opium altogether, which, certainly, is incorrect. The doses should be small, and they may be repeated frequently. Administered in this manner, opium can be used with perfect safety both internally and in an enema. For, when the doses are small, it is possible to stop before an overdose has been given. One of the rules for giving opium is this—the child should not be waked up for the purpose of taking the medicine. Opium does not always act as a depressant, but sometimes as an excitant. This difference in the effects produced by the drug are well known. Very small doses will act as an excitant, while relatively large ones will act as a depressant. The exciting doses, will, when accumulated, also show their constipating effect, and whenever there is fear of collapse, it is safer to give $\frac{1}{20}$ of a grain (0.0003) every half-hour or hour, than to administer $\frac{1}{30}$ of a grain (0.0012) every two hours.

Alcohol.—Small and frequent doses will certainly stimulate the nervous system, digestion, and circulation, and they

also stimulate the skin and increase perspiration. Alcohol, given in this manner, certainly arrests fermentation. Moreover, it takes the place of food, and will act favorably as food when no solid carbo-hydrates are tolerated by the intestinal tract. As it is absorbed in the stomach, so does it protect the intestinal tract. It has been found that, when only small quantities of milk and pure alcohol and water are given as food, the body increases in weight. But it is absolutely necessary that the alcohol or the alcoholic preparation should be pure. Fusel oil will dilate blood-vessels, produce and increase congestion, and prove dangerous. Where no good brandy or whiskey can be procured, it is better to use alcohol in substance diluted with water.

Finally, it is necessary to reduce the amount of secretion taking place from the surface of the intestinal tract. For that purpose astringents may be used, such as alum, lead, tannic acid, permanganate of iron, and, what has already been spoken of, nitrate of silver. In all those cases in which the stomach participates in the process to any considerable extent, almost any astringent will prove ineffective. Neither alum nor lead nor tannic acid may do otherwise than irritate the stomach, and it will be necessary to depend altogether upon nitrate of silver, or better upon bismuth, for the purpose of meeting *two* indications. To fulfil several indications at the same time, it is often good practice to combine remedies.

The main indications are to neutralize acids, to reduce nervous irritability, to arrest secretion, and to change the condition of the surface of the catarrhal mucous membrane.

For that purpose, in the generality of cases, I combine bismuth, opium, and chalk according to the following formula.

R Bismuth subnit.gr. i. (0.05)
Prepared chalk.....	grs. ij. (0.10-0.20)
Dover's powder.....	gr. $\frac{1}{8}$ (0.02)

This combination is suitable for a baby *ten* or *twelve* months of age, and the dose can be repeated every two hours. In all those cases in which acid is very abundant, it is necessary to increase the doses of antacids without necessarily giving large doses of opium.

Whenever it is necessary to stimulate, and alcohol alone does not meet the requirements, resort may be had to hot

bathing. This is especially serviceable in those cases in which the surface is cool and the temperature of the body, measured in the rectum, is pretty high. A hot bath in which the child may be kept for *two* or *three* minutes will restore some warmth to the surface, dilate blood-vessels, reduce temperature, and act as a nervous stimulant. To relieve intestinal pain, plain warm fomentations; to relieve heat, cold applications are sufficient.

Camphor stimulates the heart, and reduces temperature, and may be used internally or subcutaneously according to the necessities in the case. For subcutaneous injections camphor may be dissolved in either oil or alcohol. The effect derived from camphor as a stimulant is not permanent, but still very much more permanent and steady than that produced by carbonate of ammonia.

The dose may be from $\frac{1}{4}$ to $\frac{1}{2}$ a grain (0.015-0.03) every hour or two, when only a moderate stimulation is required. In urgent cases it may be given in doses of from *five* to *ten* grains (0.3-0.6) in the course of an hour, and usually the effect will be favorable.

It is, however, only in cases in which real collapse is present that doses of five or ten grains will be required, and it may then be administered dissolved in alcohol, and with or without musk.

There is no remedy that will act more favorably in conditions of great debility and collapse—collapse with or without spasmodic symptoms—than *musk*. It is true it is scarce, very frequently spurious, is expensive, and must be given in larger doses than usually recommended. But in cases of collapse, doses of five or ten grains (0.3-0.6) should be given at once, and should be repeated every half-hour or hour. More than two or three such doses will not be required to yield a result.

The dysenteric miasma¹ being unknown, the rules commonly obeyed in the hygienic management of all miasmatic and infectious diseases are valid in an epidemic of dysentery as well. Streets, water-closets, and sewers must be disinfected effectively, dwellings and hospital wards vacated from time to time, and

¹ Compare the author's essay on Dysentery in Gerhardt, *Handb. d. Kinder-Krankheiten*, Vol. II., 1878.

individuals protected by frequent and careful ablution and the disinfection of clothing. Special care ought to be taken lest many dysenteric patients be admitted to children's or, in fact, all hospitals. Their number ought to be limited when they are admitted to special wards, and smaller than that of typhoid fever patients when received in general hospitals. Dysenteric evacuations are to be disinfected and removed, soiled bed-linen disinfected and washed.

Those in relative health are to give the greatest possible care to their digestive organs. Indigestible food must be avoided rigorously during an epidemic. Vegetables containing a large percentage of cellulose, salads, cabbages must be refused to children of even advanced age, and even ripe fruit ought to be refused as a rule. Even healthy children of three or five years will, now and then, without apparent cause, under normal circumstances pass soft peas or whortleberries, though well prepared, while there is no apparent change along the whole length of their alimentary canals. Animal milk, too, requires great care when given to younger children, nay, common cases of diarrhea require that the amount of milk given them should be rescinded. Cow's milk, when unmixed or mixed with water only, acts in part as an irritant during an epidemic or individual disposition to diarrhea. In regard to that, I have heretofore laid down the rules according to which cow's milk, unless there are positive indications for total abstinence, can be rendered digestible. More: great care ought to be taken lest the physiological constipation resulting from the unusual length of the colon descendens and the doubling and even trebling of the sigmoid flexure should act as a cause of disease. At all events, one or two enemata must be given daily. They are also, and even more so, required where habitual constipation depends upon rachitical debility of the muscular layers of the intestinal tract. When there is an actual indigestion from either alimentary or atmospheric causes, a purgative is required. I prefer a single effective dose to small refracted administrations, but no drastic to a child of one or two years. Five or ten grains (0.3-0.6) of calcined magnesia, three or six grains (0.2-0.4) of calomel, with an alkaline addition, one or two teaspoons of castor oil, half a teaspoonful or less of the fluid extract of *rhamnus frangula*, act both effectively

and agreeably. Pain and tenesmus may be prevented by the addition of codein, or extract of opium, both of which have less of the constipating effect of the gum, or by extract of hyoscyamus. I need not add that in times like these the usual care is to be taken of the general health. Woolen or canton flannel undergarments ought to be changed every morning or night, so that they have ample time to get rid of the accumulated moisture. The stockings also ought to be of wool or thick cotton, must cover the entire leg and part of the thigh, and be changed frequently.

When the disease has made its actual appearance, the diet requires great attention. Altogether it would be wrong to force nourishment into a patient whose appetite is impaired and fever high in the very beginning of the disease. But there is hardly another disease in which consumption and emaciation are so rapid by both actual expulsion of substance and nervous exhaustion as in dysentery. Therefore, the little patients ought to be supplied soon with a certain amount of food. Barley-water with milk, or barley-water with milk and the whites of eggs, will suffice for a long time, and will prove digestible; if not, small doses of pepsin with muriatic acid, or lactopeptin, or bismuth, or pancreatin, or milk prepared according to the plan of Dr. Rudisch, will enhance their digestibility. In some cases, broiled or raw beef, in small quantities, but frequent doses, is well tolerated, provided that the stomach and small intestines have not participated in the actual morbid process from the commencement. This happens very often, indeed. In every feverish disease, and mainly such of the abdominal organs, saliva is reduced in quantity, and the stomach less liable to digest. Besides, a large tract of mucous membrane is sore or inflamed, and liable to be irritated by passing solids, meat fibre, casein, cellulose. Whenever the tongue is coated, the region of the stomach irritable, it is best to refuse even raw beef and milk, until the tongue begins to be more normal. Nay, even Leube's beef solution, one of the sheet-anchors during recovery, ought to be dispensed with, except in conditions of great urgency. Beef-tea is contraindicated. I emphasize that fact, as one of the first general advices in the practice of many of us is the administration of beef-tea, in regard to which, I refer to such remarks as I made before.

All nourishment ought to be tepid. Ice increases peristaltic motion and gives rise to pain and tenesmus. So do effervescent beverages, Selters, Appollinaris. In mild cases, particularly in the beginning, stimulants, either alcoholic or other, are not required. But I do not share the opinion of such as forbid them absolutely; on the contrary, they will prove both pleasant and effective during the periods of increasing debility and convalescence. In these conditions, from half an ounce to two ounces (15.0–60.0) of brandy or whiskey daily, in small and frequent doses, and largely diluted with mucilaginous or farinaceous fluid, are very salutary, not to speak of the cases of great debility and actual collapse. In such conditions, there is hardly a dose of alcoholic or other stimulants which, where temporarily required, ought to be considered too large. Ten grains of camphor and four ounces of brandy administered to a child of two years in such a condition, during a single hour, I know to have saved its life. It is better for children to take in the course of one day three or six ounces of brandy, ten or twelve grains of camphor, or twenty or thirty grains of musk, than it is for parents to bury them on the next.

The regulation of the surrounding temperature is of great importance, even in the mildest cases. What appears a mild case to-day may be a serious one to-morrow. The temperature of the room need not be above 70° F., but the little patient ought to be in bed and well covered. His linen must be warmed before being put on, changed frequently, the body often washed, particularly the anus; bed-pan and evacuations disinfected, windows opened. The feet have a constant tendency to get cool and ought to be warmed constantly. One tepid bath at least ought to be taken daily; for no other purpose the patient must leave his bed. Tepid fomentations will alleviate colic, warm injections tenesmus. Of these latter I shall have to say more.

In many mild or moderate cases, this dietetic treatment of an attack of dysentery may suffice, but its effect is not to be relied upon solely, for at any moment medicinal treatment may become urgently indicated. Personally, I almost feel like counting the administration of a mild purgative in the first commencement of a dysenteric attack among the dietetic indications. A copious evacuation from the bowels appears to

be an essential aid in procuring a mild course for the incipient morbid process. When, after all, a rapid recovery can no longer be expected, after these dietetic measures, the indications for treatment are plain. The local morbid process is to be inhibited, the peristalsis to be moderated, the irritability of the intestines to be reduced to a minimum, and the morbid products removed both as quickly and gently as possible.

As I said before, I like to begin the treatment with a purgative. Calcined magnesia (with or without some salicylate of soda, according to the condition of the stomach), castor oil with opium, the fluid extract of senna or rhamnus frangula, or from three to eight grains of calomel, to be followed by a dose of Dover's powder. I am well aware of the objections to mercury, and know of but few indications for its administration except in syphilis. Its protracted use, although it is not so apt to give rise to stomatitis as it is in adults, may still prove so deleterious in its effect upon the general system that this application has been greatly rescinded in the last twenty years of my practice. The objection alluded to is, however, more valid in regard to small and frequent doses than to single larger ones, and cannot contradict, therefore, the warm recommendations of calomel on the part of, particularly, English physicians. Still, purgatives are indicated in the *commencement only* of dysentery, not through its whole course, as has been advised in the dysentery of adults. In the latter, accumulations of feces of old date are not at all rare, in fact there are very few adults where they may not be met with. In children the intestines are smaller, the contents more liquid, relaxations and diverticles rare, and accumulations less frequent and less copious. Thus, though adults may require purgatives in the course of a dysenteric attack, children, as a rule, do not require such a repetition. But lately a young friend was, by the advice of a consulting physician, awed into giving a purgative in the third week of a dysentery doing well on bismuth and opium; to some disadvantage. Where, however, an indication appears to arise, the purgative ought to be castor oil or magnesia, no longer calomel or a drastic.

We know of many recommendations of emetics. Their effect was described as revulsive; their general and principally

their diaphoretic powers were praised. Still I think that a warm bath and warm beverages, while they are just as effective, are less violent. Ipecacuanha has been recommended more than any other remedy of that class, but not for its emetic effect. On the contrary, McLean, Woodhull, and others insist upon avoiding the nauseating effect. McLean administers a hot bath, and a dose of opium or chloroform. This is followed by a dose of twenty-five or forty grains of ipecac; he allows his patient to suck ice, but no drink for two or three hours, and uses sinapism or oil of turpentine as derivants. A smaller dose of ipecac is given after eight or ten hours. Sometimes another dose of eight or twelve grains is required on the following day. Recovery is said to set in soon. This ipecac treatment is reported to have resulted, amongst the military in England, where it was first introduced, as "*radix anti-dysenterica*," in better statistics than the former routine treatment with mercury and depletion. The latter I cannot recommend. Except the anus, no tangible locality has blood-vessels connected with those of the diseased mucous membrane. There is no indication for leeching the abdominal surface as long as there is no complication with peritonitis. Generally the consumption of blood is so large in dysentery that saving blood is more advisable than taking.

Great sensibility of the left hypogastric region and heat will be alleviated, however, by the application of ice. But it must not be forgotten that very young infants bear ice but a short time, whether applied to head or abdomen. I advise to watch the effect of the application either of the ice bladder or the ice-cold cloth. Now and then, even in adults, we meet with an idiosyncratic incompatibility with cold. It has to be taken into account. Sometimes warm applications of either water or poultices prove more efficient in regard to the two indications, which consist in alleviating irritation and reducing temperature. Sometimes a simple warm application, which may be changed every few hours, or a cold application which is permitted to get warm on the skin, will result in reducing both pain and temperature, as both physiological laws and therapeutical experience may lead us to expect.

Opium (and its alkaloids, morphia and codeia) is invaluable in dysentery, notwithstanding the contrary opinion of a num-

ber of authors. The objection to its use is decidedly exaggerated. Such accidents as have been reported in the journals to result from its administration must be attributed to the fact that either the dose was absolutely or relatively too large compared with the idiosyncrasy of the little patient. Dysentery both requires and tolerates larger doses of opium than an average diarrhea. In this respect this disease stands abreast with peritonitis. The main indications are to relieve pain, reduce peristalsis, and diminish the copious serous secretion; no other remedy fulfils all of them so well. For this purpose it ought to be given internally; for enemata containing opium may act favorably, but the more intense the tenesmus the less reliance can be placed on its effect, and the amount of the opiate thus brought into real action cannot be estimated. From amongst the opiates I prefer a tincture, or the wine, or opium in substance, or Dover's powder; but rarely have I injected morphia under the skin. The effect of the drug is easily watched and controlled, by commencing with moderate doses, not repeating them too often, and being guided by the effect obtained. If opium is to be replaced, opium with hyoscyamus, or with belladonna, or hyoscyamus or belladonna alone, may take its place temporarily.

After the purgative administered in the first stage of the disease has proved efficient, astringents ought to be resorted to at once. They may either be given in combination with opium or separately. They are expected to pass wholly or partly through the entire length of the intestinal canal, thus coming in contact with the inflamed and ulcerous mucous membrane. Amongst those eligible are tannin, gallic acid, and vegetables containing the same (ratanhia, cinchona, catechu), besides subacetate of lead, nitrate of silver, and per-nitrate of iron.

The daily doses of tannin range from eight to fifteen grains, (0.5 to 1.0) with opium or Dover's powder, lead in doses somewhat smaller, nitrate of silver one-sixth of a grain to one grain (0.01 to 0.06) in plenty of water, liquor pernitratiss ferri fifteen to fifty minims, in a mucilaginous or farinaceous vehicle. The single doses ought to be but small, but their administration frequent. There is another remedy which, in my estimation, stands very high, viz., the subnitrate or sub-

carbonate of bismuth. Not only does it cover and protect the mucous membrane, but it also has a decided anti-fermentative effect. Thus it is surely indicated in irritated conditions of the mucous membrane; it seldom fails when given in sufficient doses. There is no harm in sometimes giving it in such doses that part of the introduced material will pass through the entire length of the intestinal tract without undergoing decomposition. As its taste is not disagreeable, it may be given together with tannin and opium; the daily dose ought not to be less than one drachm or a drachm and a half (4.0 to 6.0). At the same time the passages ought to be examined as to their reaction. Abundant acid, so frequently found in the slightest intestinal anomalies, requires the additional administration of alkalies. In most cases carbonate of lime is preferable to either magnesia or the carbonate or bicarbonate of soda, the salts of both of which are apt to increase diarrhea. Sometimes, particularly when the stomach can be relied upon, the salicylate of soda may be added to the internal treatment. Besides the favorable effect of the soda in the intestinal tract, the salicylic acid may prove beneficial both by its anti-febrile and disinfectant action. In regard to the use of lime-water, I refer to some previous statements.

At the same time accidental complications may yield their own indications. McLean reports many cases of complications with malaria, necessitating the use of quinia; others cite scurvy requiring antiscorbutic treatment.

When the catarrhal or inflammatory form of dysentery be complicated with diphtheritic deposits or degenerations, either superficial or deep-seated, or when large portions of mucous membrane be expelled and ulcerations be developed, the indications for energetic treatment become more and more urgent. Local treatment is required to astringe, to disinfect, to produce new granulations. For that purpose astringents, carbolic and salicylic acid may be resorted to. To what extent local treatment can be useful, G. Thomas has proved but lately in a very tedious and protracted case. A lady suffering from chronic dysentery through many years, and reduced to the lowest possible degree, recovered within a short time under the repeated applications of a small amount of concentrated

nitric acid made to the surface of the ulcerated rectum through a speculum.

The local treatment requires the use of enemata. Their indications vary. They are to evacuate the bowels, or to reduce the irritability of the diseased intestine, or to accomplish an actual cure. These indications cannot always be fulfilled separately; sometimes two, sometimes all three can be fulfilled at the same time. The nature and quantity and the temperature of the liquid to be injected depend in part on the end aimed at, in part on the irritability of the individual intestine. Sometimes the bowel objects to the introduction of small amounts; sometimes, however, large quantities are tolerated very easily indeed. To introduce small amounts, the selection of the syringe is a matter of indifference. To inject large quantities, however, undue pressure and local irritation must be avoided. Thus the fountain syringe alone will answer; it ought to hang but a trifle above the level of the anus, say from six to twenty inches. The temperature of the liquid is not always a matter of great importance. Some recommend the injections to be ice-cold, some, however, tepid; both are frequently recommended as panaceas. But the practitioner will soon ascertain that some bear and require the one, some the other, some indeed very hot ones.

In my experience, for the large majority of patients tepid injections answered best. Not seldom is the intestine in such a condition of irritation that even small quantities of a very cold fluid are expelled at once. And again, there are cases in which enormous amounts of either cold or warm water are readily received. To accomplish the purpose of evacuating the bowel, plain water will often suffice, but one-per-cent solutions of salt in water will usually prove more acceptable. Additions of bitartrate of potassa, or castor oil, have proved so uncomfortable in my hands that I have discarded them long ago. However, when the secretion of mucus on the rectal mucous membrane was very large, one or two-per-cent solutions of bicarbonate of soda answered very well indeed. For the purpose of clearing the intestines, either of feces or the morbid products, a single enema is insufficient. It ought to be repeated several times daily. When much mucus is secreted and tenesmus intense, it may be applied after every

evacuation. In many cases the substitution of flaxseed tea or mucilage of gum acacia will prove advantageous. I had to continue them for weeks for both their evacuating and alleviating effect. When, however, the latter effect alone is aimed at, small quantities will usually suffice. An ounce or two of thin mucilage, or starch-water, or flaxseed tea, with tincture of opium, or better, extract of opium, prove very comforting. Glycerine in water has been recommended for the same purpose. The former alone, or but slightly diluted, irritates, nay cauterizes. It will require close judgment and individual experience to ascertain the degree of dilution.

When a local curative effect is aimed at, injections of small quantities will be found deficient. As the local lesions are often extensive, the amount to be injected must be pretty large. Almost always astringents are required. Sulphate of zinc, of alumina, subacetate of lead, nitrate of silver, tannin, chlorate of potassa, ergotin, salicylic and carbolic acids, and creasote have been recommended. Of the more common astringents I prefer alumina or tannin in one-per-cent solutions. Creasote answered well in solutions of one-half of a per cent. Salicylic acid resulted more frequently in pain than in benefit. Carbolic acid in solutions of one-half of a per cent has proved very beneficial, but I have learned long ago to be very careful in regard to its administration when I observed a case of poisoning with that substance. A young man suffering from chronic dysentery was to be treated with injections of carbolic acid in a one-per-cent solution. As it was expected that but a limited quantity would be tolerated before expulsion, no amount was specified. The intestine, however, being in a paralytic condition, received enormous quantities, until finally ten drachms (40.0) of crystallized carbolic acid disappeared in his bowels. That want of caution came near destroying the patient.

Injections of nitrate of silver may prove very useful in cases not quite acute. Before the solutions of a quarter of a per cent, or one, or two per cent are injected, the intestine ought to be washed out with warm water without salt. After the injection has been made, it ought to be neutralized with a solution of chloride of sodium; it is still better to wash the anus and the portion of the rectum within easy reach with

that solution before the medicinal injection be made. For even the mildest solutions are liable to give rise to intense tenesmus, when no such care has been taken.

In chronic cases, where the ulcerations are but few, or in the lower portion of the bowels only, small quantities suffice. But more acute cases and extensive lesions require large injections, the patient being on his side, or in the knee-elbow position. In a number of cases, both mild and severe, where neither the usual astringents nor nitrate of silver appeared to answer, I have been very successful when resorting to injections of subnitrate of bismuth. The drug is mixed with six or ten times its amount of water; of this mixture from one to three ounces (30.0–100.0) are injected into the bowel which has been washed out previously, twice or three times daily. The success was satisfactory, though a large portion of the injected mixture was soon expelled.

Suppositories containing the above substances may prove beneficial. But in order not to irritate they must be so soft as to melt readily. They may always contain some opium. But its admixture is not always sufficient to relieve the irritability of the rectum. For to accomplish this end, opium must at least begin to liquefy and to be absorbed, and absorption cannot be relied upon except where a part, at least, of the mucous surface is in a tolerable state of integrity.

